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EXPERIMENTS ON THE GROWTH OF WHEAT.

The Rothamsted Experiments on the Growth of Wheat, Barley, and the Mixed Herbage of Grass Land. By William Fream, B.Sc. Lond., LL.D., Professor of Natural History in the College of Agriculture, Downton. (London: Horace Cox, *Field* Office, 1888.)

THE long series of reports which have emanated from Rothamsted since 1847, and which lie buried to most readers in the Journals of the Royal Agricultural Society, as well as in those of our more purely learned Societies, have long needed an editor. Back numbers of serials are not particularly attractive to the modern reader. The laborious papers by Sir John Lawes and his indefatigable colleague Dr. Gilbert would have run some little danger of being buried alive had not an able editor and exponent been found. Happily, Dr. Fream possessed the necessary knowledge and discrimination for this task, and, with the entire concurrence of the original investigators, the upshot is a valuable digest of a certain section of the results obtained—namely, those relating to the cereals and the grasses. The volume is adapted for reference rather than for rapid reading, although the sections upon the influence of climate on the cultivation of wheat, and upon the home produce, imports, and consumption of wheat, are less close in fibre, and may be scanned with greater ease. The book is, in fact, rather for students than for the omnivorous reader, but nevertheless appeals to a very large constituency. All landlords, land agents, and farmers, as well as agricultural students (now a numerous class), will welcome it as giving, in a compendious form, and in digested condition, matter which is scattered through many periodicals.

The results of continuous wheat and barley growing year after year upon the same land—without manure of any kind, with annual dressings of dung, with annual dressings of nitrogenous manures, with annual dressings of mineral manures, and with annual dressings of mixed nitrogenous and mineral manures—are all given. The fact that wheat and barley have been grown for forty years in succession without manure upon the same land, while the entire straw and grain have been removed, is in itself striking, and still more singular is it that the average produce during all these years is equal to the average yield of Australia, and exceeds that of many of the United States of America. It is also noteworthy that the yield of the last crop comprised in these reports—that of 1883—is 13¾ bushels per acre, or within one-fourth bushel of the average during the entire period of forty years. With regard to manures, minerals alone have added very slightly to the unmanured produce; whereas, manures containing nitric acid alone, or some easily nitrifiable compound of nitrogen, have considerably increased the crop. Manures consisting of potash, phosphoric acid, and nitrogen in the form of ammonia salts or nitrates, are able to grow heavy crops of wheat continuously. It is clearly shown that such compounded fertilizers, containing both the mineral and nitrogenous constituents of plant food, can grow crops superior to what are produced by annual dressings of fourteen tons per acre of farmyard manure. Also the proportion of the nitrogen applied which is made use of by the growing crops is much higher in the case of the artificial fertilizers than in the case of the farmyard manure. A larger proportion, in fact, of the nitrogen applied is recovered by the crop in the case of the artificial dressings. On the other hand, the residuary effect of nitrogen applied in combination with carbon (as in farmyard manure) is much greater than in the case of applications of prepared salts of ammonia or of nitric acid.

The ease with which fertility can be kept up by artificial applications forms, in the opinion of many agriculturists, a reason for discarding the more cumbrous method of keeping up the fertility of land by means of live stock and the dung-cart. But it must be remembered that no artificial manure accumulates fertility in a soil like farmyard manure, and its nitrogen, being liberated gradually, is available over a long series of years, and especially so at those seasons of the year in which vegetation is most in need of it.

The grass experiments are of great interest. First, we have the different quantities of hay produced by various dressings of manurial substances; but more remarkable are the changes brought about in the species of grasses predominating on various plots by the influence of fertilizers applied during a long series of years. On the plot, for example, to which ammonia salts have been continuously applied for thirty years, the total number of the species originally extant has been much reduced, three-quarters of the produce being composed of *Festuca ovina* and *Agrostis vulgaris*. The leguminous herbage has disappeared. On the plot manured continuously with superphosphate, the number and relative predominance of the plant species is much the same as without manure, with a prevalence of *Lathyrus pratensis* among the Leguminosæ, and an increase of *Ranunculus repens*, *R. bulbosus*, *Achillea Millefolium*, and *Rumex Acetosa*. Again, when ammonia salts and mixed mineral manures are applied, *Poa pratensis* becomes the prevailing grass. These examples must suffice to show the great changes wrought by continuous applications, and the principle of the survival of the fittest under regulated alterations of the environment.

Complicated and multifarious as are these experiments, the general conclusions for the guidance of agriculturists are reducible to a few simple deductions. Thus the superior excellence of nitrate of soda as a fertilizer for cereals and for grasses is distinctly shown. The necessity of nitrogenous manures, such as nitrate of soda and ammonia salts, as means of bringing out or developing the effect of the so-called mineral manures, such as potash and phosphates, is constantly proved. The comparatively small value of many constituents of plants (owing to their already existing in sufficient quantities in most soils), such as soda, magnesia, and silica, is also placed beyond doubt. The residual effect of farmyard manure, and its consequent power of not only keeping up but indefinitely increasing the fertility of a soil, are points greatly in its favour; while the slowness of its action, and the very small proportion of its nitrogen which appears to be recoverable at any particular time, are considerations which weigh against it. The residual effect of mineral

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dressings applied many years ago as affected and brought out by continuous dressings of nitrogenous manures is another significant fact; while the evanescent effect of nitrates applied as salts contrasts unfavourably with the continued effects of nitrogenous matter in organic combination with carbon. Prof. Fream's book is a substantial addition to agricultural literature, and it is satisfactory to find that the editing of such important results has been carried out, with the "kind and ready" assistance of Sir John Lawes and Dr. Gilbert, by one who brings sound scientific attainments to bear upon a stupendous number of observations made during a series of forty years. There is room for a second, if not a third volume, as the experiments upon the cultivation of the root crops, the leguminous crops, and the elaborate researches made at Rothamsted upon the fattening of animals, are not touched in this first instalment.

THE JAPANESE VOLCANIC ERUPTION.

THE *Times* of Tuesday contains a long letter from its Japan Correspondent describing the scene of the recent volcanic explosion in the Bandai-san region in Northern Japan. This is the first account by a foreign eye-witness that has reached the outside world. The writer appears to have started immediately from Tokio for the scene of the disaster, where he spent four days going carefully over the ground, examining the phenomena connected with the outburst, and hearing the stories of the survivors. The communication which is the result of these investigations, and which was evidently written while the powerful impression left by the scene of awful desolation was still fresh in the writer's mind, is probably one of the most graphic and detailed accounts of the immediate results of a stupendous volcanic explosion that has ever been published. Bandai-san is a mountain about 5800 feet high, and has shown no sign of activity for about eleven hundred years. On its north-eastern flank was a subordinate peak known as Little Bandai-san, which rose directly above a group of three solfataras.

At about 8 o'clock on the morning of July 15 (here, as throughout almost the whole of this article, we quote the *Times* Correspondent), almost in the twinkling of an eye, Little Bandai-san was blown into the air and wiped out of the map of Japan. A few minutes later its *débris* had buried or devastated an area about half the size of London. A dozen or more of upland hamlets had been overwhelmed in the earthen deluge, or wrecked by other phenomena attending the outburst. Several hundreds of people had met with sudden and terrible death. Scores of others had been injured; and the long roll of disaster included the destruction of horses and cattle, damming up of rivers, and laying waste of large tracts of rice-land and mulberry-groves. A small party was organized in Tokio to visit the scene. As the travellers approached the mountain, they were told that twenty miles in a straight line from Bandai-san no noise or earthquake was experienced on the 15th, but mist and gloom prevailed for about seven hours, the result of a shower of impalpable blue-gray ash, which fell to a depth of half an inch, and sorely puzzled the inhabitants. An ascent of about 3000 feet was made to the back of the newly-formed crater, so as to obtain a clear view of it and of the country which had been overwhelmed. Only on nearing the end of the ascent were they again brought face to face with signs of the explosion. Here, besides the rain of fine gray ashen mud which had fallen on and still covered the ground and all vegetation, they came upon a number of freshly-opened pits, evidently in some way the work of the volcano. Ascending the last steep rise to the ridge behind Little Bandai-san, signs of the great disaster grew in number and intensity. "Fœtid vapours swept over us, emanating from evil-looking pools. Great trees torn up by their roots lay all around; and the whole face of the mountain wore the look of having been withered by some fierce and baleful blast. A few minutes further and we had gained the crest of the narrow ridge, and now, for the first time, looked forth upon the sight we had come to see. I hardly know which to pronounce the more astonishing, the prospect that now opened before our eyes or the suddenness with which it burst upon us. To the former, perhaps, no more fitting phrase can be applied than that of absolute, unredeemed desolation—so intense, so sad, and so bewildering, that I despair of describing it adequately in detail. On our right, a little above us, rose the in-curved rear wall of what, eight days before, had been Sho-Bandai-san, a ragged, almost sheer, cliff, falling, with scarce a break, to a depth of fully 600 feet. In front of this cliff everything had been blown away and scattered over the face of the country before it in a roughly fan-shaped deposit of for the most part unknown depth—deep enough, however, to erase every landmark and conceal every feature of the deluged area. At the foot of the cliff, clouds of suffocating steam rose ceaselessly and angrily, and with loud roaring, from two great fissures in the crater bed, and now and then assailed us with their hellish odour. To our eyes, the base denuded by the explosion seemed to cover a space of between three and four square miles. This, however, can only be rough conjecture. Equally vague must be all present attempts to determine the volume of the disrupted matter. Yet, if we assume, as a very moderate calculation, that the mean depth of the *débris* covering the buried area of thirty square miles is not less than 15 feet, we find that the work achieved by this last great mine of Nature's firing was the upheaval and wide distribution of no fewer than 700,000,000 tons of earth, rocks, and other ponderous material. The real figure is probably very much greater."

The desolation beyond the crater, and the mighty mass thrown out by the volcano which covered the earth were almost incredible. "Down the slopes of Bandai-san, across the valley of the Nakasegawa, choking up the river, and stretching beyond it to the foot-hills five or six miles away, spread a vast billowy sheet of ash-covered earth or mud, obliterating every foot of the erstwhile smiling landscape. Here and there its surface was dotted or streaked with water. Elsewhere the eye rested on huge disordered heaps of rocky *débris*, in the distance resembling nothing so much as the giant concrete block substructure of some modern breakwater. It was curious to see on the farther side the sharp line of demarcation between the brown sea of mud and the green forests on which it had encroached; or, again, the lakes formed in every tributary glen of the Nakasegawa by the massive dams so suddenly raised against the passage of their stream waters. One lake was conspicuous among the rest. It was there that the Nakasegawa itself had been arrested at its issue from a narrow pass by a monster barrier of disrupted matter thrown right across its course. Neither living thing nor any sign of life could be descried over the whole expanse. All was dismally silent and solitary. Beneath it, however, lay half a score of hamlets, and hundreds of corpses of men, women, and children, who had been overtaken by swift and painful deaths."

Near by two houses, built for the accommodation of visitors to the hot springs were overwhelmed, and a little lower down two spa-hamlets were absolutely buried in mud. From various indications, especially a comparison of the places destroyed with those saved, it appears that the disruptive force must, in the main, have been directed outwards from the hill-face at a considerable inclination to the vertical. On no other hypothesis is it possible to account for some of the most startling phenomena, for the great distances reached by the waves of *ejectamenta*, and for the incredibly brief intervals that

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